ATTACHMENT 8
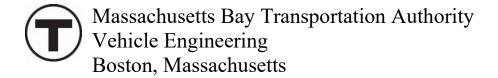
LICENSE PLATE

RECOGNITION SYSTEM

FOR

PROCUREMENT OF 40 FT LOW-FLOOR

BATTERY ELECTRIC BUSES

SPECIFICATION NO. VE21-054

Massachusetts Bay Transportation Authority
Vehicle Engineering
Boston, Massachusetts

1.1   LICENSE PLATE RECOGNITION

A.   This Section specifies the installation of a License Plate Recognition system on MBTA buses. The LPR system shall integrate to the existing MBTA Video Surveillance system that is a real time IP video system utilizing IP based cameras. The video is viewed throughout the MBTA system using the Genetec Security Center client. The LPR system and installation will comply with all general, product/material, execution, installation, testing, and software update requirements detailed in TS Attachment 2 and 3.

B.   The LPR software installed on fleet hardware must support a non-proprietary, open architecture platform which is fully ONVIF profile S and G compliant.

C.   The CCTV system utilizes the MBTA's Security Wide Area Network (SWAN) and MBTA's Wide Area Network (WAN) as a means of transmitting LPR data to various locations throughout the MBTA system for viewing statistics. The system expansion shall incorporate LPR cameras, LPR Processing Units and any other hardware or software required to wirelessly transmit/receive LPR data over the IP network for a complete and functional system.

D.   The Genetec client allows MBTA personnel to access LPR video streams and events from any camera, or processing unit on the system and to query stored information and snapshots. The Genetec clients are currently installed on multiple computer workstations within the six (6) Hub Centers, Operations Control Center, and on individual computer workstations throughout the MBTA network.

E.   This contract requires the Contractor to coordinate with the MBTA Security and Emergency Management Department and MBTA's CCTV Maintenance Contractor (MCMC) via the MBTA Project Manager to inform them of, and schedule work associated with, integrating alarms and video streams with the existing Genetec core directories.

F.   Contractors will be responsible for coordinating with the MBTA on the installation of a License Plate Recognition System (LPR) on vehicles. Contractors shall work with vehicle engineering and MBTA Security to determine ideal placement for LPR Camera Units for maximum hit detection with minimal impact to the envelope of the vehicle.

G.   Any and all licensing or plug-in costs required to provide an operational LPR head end and standalone systems shall be the responsibility of the contractor. In addition, all licensing and plug-ins provided by the contractor shall be added to existing core MBTA services.

1.2   MOBILE LPR CAMERA UNITS

A.   Mobile Camera Units (MCU) shall be installed and mounted on to the vehicle in accordance with engineering best practices and following manufacturer guidelines for maximum hit detection of license plates. Prior to installation of MCU the contractor shall have and approved placement of the MCU by MBTA Vehicle Engineering.

B.   The camera unit shall have a monochrome progressive scan ALPR camera with a resolution of 1024X946(XGA).

C.   The camera unit shall have a color context camera with a resolution of 640x480 @ 30fps

D.   The ALPR camera shall be able to be equipped with a 16mm lens.

E.   The camera unit shall have an operating temperature range from -40°F to 140°F (-40°C to 60°C)

F.   The camera unit shall have a storage temperature range of -40°F to 185°F (-40°C to 85°C)

G. The camera unit shall support vibration according to standard MIL-STD 810G 514.6 (Figure 514.6 C-1)

H. The camera unit shall resist bumps according to standard IEC 60068-2-29 (Directions: $\pm$ X, $\pm$ Y, $\pm$ Z)

I. The camera unit shall resist shock according to standard MIL-STD 810G 516.6

J. The camera unit shall be sealed according to standard IP67 IEC 60529

K. The camera unit housing shall have an extruded aluminum housing

L. The camera unit housing shall have T-Slots on either side for universal mounting

M. The camera unit shall have following available mounting accessories:

    1. Hard mount

    2. Snow, rain, and sun visor

N. The camera unit shall have an integrated pulsed LED illuminator shall be 850nm wavelength. The camera shall be in the non-visible spectrum of the human eye and will have no visible IR output when facing the vehicle.

O. The camera unit shall have up to a 100-foot (30-meter) reading range with XGA or 70-foot (21-meter) with VGA cameras

P. The camera unit shall have a dimension of 1.65 (H) $\times$ 4.75 (W) $\times$ 4.75 (D) inches (4.2 $\times$12 $\times$ 12 cm) maximum; excluding cabling and mounting brackets

Q. The camera unit shall have a weight of 1.5 lbs (0.7 kg) maximum

R. The camera shall have dynamic exposure allowing all-weather reading of dirty or obstructed plates. The camera shall be able to read at skew angles up to 45 degrees

S. The color context camera shall use CMOS technology to capture color images in low light conditions.

1.3   MOBILE LPR CENTRAL PROCESSING UNIT

A. The central processing unit shall have support for international license plate reading

B. The central processing unit shall have two dedicated Atom TM E3845 processor(s).

C. The central processing unit shall have up to 4 ALPR camera unit inputs

D. The central processing unit shall have 2 10/100/1000 Base-T Ethernet ports

E. The central processing unit shall have 2 dry-contact inputs

F. The central processing unit shall have a 12V/500mA auxiliary power output

G. The central processing unit shall have 2 output relays

H. The central processing unit shall have an operating temperature range from -40°F to 150°F (-40°C to 65°C)

I.   The central processing unit shall have a storage temperature range of -40°F to 185°F (-40°C to 85°C)

J.   The central processing unit shall meet the conformities IEC 60068-2-1 Category Ad | IEC 60068-2-2 Category Bd | IEC 60068-2-14 Category Na

K.   The central processing unit shall have a high-temperature auto shutoff protection mechanism

L.   The central processing unit shall operate on a 12-24VDC power supply @ 60W

M.   The central processing unit shall have a dimension of 12.6 × 8.6 × 4.72 inches (32 × 22 ×12 cm), maximum.

N.   The central processing unit shall be rated, and have brackets allowing for horizontal or vertical mounting

O.   The central processing unit shall have a stabilizer bar with integrated wire strain relief

P.   The central processing unit shall be able to output plate reads in a user-configurable XML format

Q.   The central processing unit shall have a weight of 7 lbs (3,2 kg), maximum.

R.   The central processing unit shall possess the following certification for vibration: MILSTD-810G Method 514.6C, Cat 4

S.   The central processing unit shall possess the following certification for shock resistance 60068-2-27 Test Ea | IEC 60068-2-31 Test Ec, Procedure 1 Page 29 of 38

T.   The central processing unit shall possess the following certification for electromagnetic immunity & emissions: FCC part 15 Subpart B | ICES-003 Issue 4 | CISPR32 / EN 55032 | CISPR24 / EN 55024 | CISPR25 / EN 55025 | EN 50498

U.   The central processing unit shall possess the following certification for EMC Directive (CE Marking): 2014/30/EU | 2004/104/EC

V.   The optical character recognition software shall be embedded in the ALPR Processing Unit and be based on a deep neural network specifically design to read license plates and other vehicle characteristics.

W.   The deep neural network shall be specifically trained with Monochrome images of licenses plates that originated from the ALPR camera.

1.4   GENERAL LPR SYSTEM INTERFACE

A.   The LPR software shall seamlessly integrate into the MBTAs existing Genetec Security Center.

B.   The system shall be able to capture vehicles up to differential speeds of 200MPH (320 km/h) to 220mph (355 km/h)

C.   A fully equipped vehicle shall be able to process up to 5,000 license plate reads per minute using 4 cameras

D.   The in-vehicle software shall be able to automatically start and shutdown according to the status of the ignition of the vehicle

E.   The in-vehicle software shall be able to run in automatic mode without any user intervention

F.   The in-vehicle software shall support up to 4 channels of ALPR and process license plate reads from all channels, or one channel at a time (user selectable)

G.   The in-vehicle software shall download all settings configured centrally from the BackOffice (BO) wirelessly (using any technology supported by the MDC) or by USB key

H.   The in-vehicle software shall download all software updates configured centrally from the BackOffice (BO) wirelessly (using any technology supported by the MDC) or by USB key

I.   The interface shall provide a live feed of the ALPR cameras units (for both the ALPR and context camera) to use for calibration, as well as a manual override on the ALPR camera exposure settings (default mode is set to automatic)

J.   The interface shall provide a form for manually capturing a license plate outside the field of view of the ALPR cameras

K.   The interface shall display for every license plate read the license plate sub image, context image of the vehicle, license plate number, GPS location, and timestamp

L.   The interface shall have image magnification controls for the vehicle context image with scrollbars to navigate thru the image

M.   The interface shall display the current date and time in real-time

N.   The in-vehicle software shall support BeNomad maps

O.   The interface shall be able to toggle to a map view to view the license plate reads plotted on a Map. The map shall have dynamic zoom and pan controls.

P.   The interface shall display the current address and block information (if available on map) in real-time

Q.   The in-vehicle software shall support multiple hotlists (blacklists) matching with lists up to 14 million entries long

R.   The interface shall have an indicator to show the real-time status of the hotlist and permit lists (loading in progress, loading complete, error)

S.   The in-vehicle software shall have configurable matcher settings applicable to hotlist matching and permit enforcement (OCR equivalents, etc.)

T.   The interface shall display hotlist hits with a custom color and sound

U.   The system can dynamically update the hotlists and contents of the hotlist from the back office during operation if equipped with wireless connectivity

V.   The in-vehicle software supports incremental hotlist updates

W.   The interface will allow to edit a license plate read that was incorrectly read (in the event of a hit)

X.   The interface will allow to accept/reject a hit. An acceptation or rejection will present a form to select from custom reasons. System may also prompt the operator to input notes relating to a hit accept

Y.   The interface shall have a visual indicator which specifies from which channel the license plate read originated from

Z.   The interface shall have a visual indicator of pending alarms

AA.   The interface shall have an interface to select the zone of enforcement, which could be a county or municipality or any other geographical zone

BB.   The in-vehicle software can circle the license plate in the context image

CC.   The interface shall have a diagnostic page to display the real time health of the system

DD.   The interface shall have a way to manually toggle license reading on/off

EE.   The interface has a page to review reads and hits, which may be scrolled thru manually or searched against

FF.   The interface has a form to enter New Wanted vehicles dynamically into the hotlist, which can have a user-selectable expiry date. Operator can also select attributes from pre-populated forms to describe the entry, as well as enter up to 200 characters of text

GG.   The in-vehicle software can transfer read/hit data in real-time to the BackOffice wirelessly (using any technology support by the Mobile Data Computer) or thru a USB key

HH.   The in-vehicle software can offload the read/hit data at the end of the shift to the BackOffice wirelessly (using any technology support by the Mobile Data Computer) or thru a USB key

II.   If the offload is done wirelessly, the in-vehicle application must be able to support 256 bit Rijndael encryption of the offloaded data

JJ.   The in-vehicle software read/hit wireless transmission shall support buffering to a queue should the connection temporarily be lost

KK.   The on-board LPR software must analyze each frame and does not need external input/output triggering to read the license plate in the camera's Field of View (FOV).

LL.   The on-board LPR software must be able to detect and read license plates with embossed characters, flat characters, and any kind of paint/background.

MM.   The on-board LPR software must be able to detect and read license plates with a maximum angle of 45° in front and 70° in depth.

NN.   The on-board LPR software must contain an OCR equivalent optimization system to improve discrimination between the similar characters for the license plates in the specific country, state, or region of the world where it is used

OO.   The on-board LPR software must be able to detect and read several types of license plates such as vehicle license plate with one line, two lines, motorcycle, different alphabets on same plate, etc.

PP.   The on-board LPR software must be a font independent system. Consequently, if license plates contain several font types or new fonts are used in the area, the system will not need an upgrade to handle these new license plate with these fonts.

QQ.   The in-vehicle application may be installed on any customer-provided MDC corresponding to the minimum specifications attached.

RR.   When in-vehicle mapping is enabled, user may navigate in the map view, zoom in and zoom out of the map view.

SS.   The in-vehicle application must support the capability to manually capture a still image with the overview camera.

TT.   The in-vehicle application must support the capability to automatically capture a vehicle context image with a manually entered license plate read.

UU.   The in-vehicle application must support live feed of the context camera such that a user can maneuver the vehicle to optimize the context image before a manual capture.

VV.   When reviewing reads and hits, a user may search for a full or partial license plate in the database, with OCR equivalents and fuzzy matching, to determine if a particular license plate has been captured in the system.

WW.   The in-vehicle application must be configurable for read privacy control. With read privacy control, a stored read does not include a license plate image cut out, a context image or a license plate interpretation. A stored hit will include a license plate image cut out, a context image and a license plate interpretation irrespective of the configuration of read privacy control.

XX.   In order to safeguard the chain of custody, the in-vehicle application supports data watermarking, which electronically marks every read and hit. If this information were to be modified in any way, the corresponding watermark would not match the data and this would be displayed in the Back-Office application for review.

YY.   The in-vehicle application must be able to display statistics on the stored reads and hits including, but not limited to, count per camera and count per hit type.

ZZ.   The system must be capable of capturing license plates in any of the following modes: an adjacent lane on either side of the vehicle while driving through traffic and/or parking lots; traffic in an adjacent lane while parked on the side or shoulder of a roadway; any parking application from parallel, 45° to perpendicular parked vehicle orientation with respect to the movement of the LPR equipped vehicle; an adjacent lane to capture the rear license plate of the vehicle as it passes the LPR equipped vehicle unit or vice versa

AAA. The application must be responsive in comparing a captured license plate against multiple and voluminous databases with less than a 2 second response to a query of a database containing up to 14,000,000 entries.

BBB.   Upon receiving a hotlist hit, the in-vehicle application will display the following information: Image cut out of the license plate, Color context image of the vehicle, License plate interpretation, Camera identification, Date and timestamp, GPS coordinates or, as an option, street address and map view of the location of the hit, Hotlist attributes including name, priority and color, Multiple hit indicator i.e. has this read license plate been matched against more than one hotlist entry, Other fields on the hotlist such as plate state or category, VIN, etc.

CCC.   Any hits which have not been acknowledged by the user shall be displayed as unresolved hits in the interface until they are acknowledged or resolved. The system must continue to process license plate data in the background and all captured data must be stored.

DDD. The system must alert the user of subsequent hits while reviewing hits

EEE.   The system must be configurable to limit the number of hits against each hotlist category

FFF.   Upon a hit, if the hotlist hit license plate does not correspond to the actual license plate cut out image, the user may select to edit the license plate interpretation. The original hit is automatically rejected, and the edited license plate is automatically matched against the hotlist database.

GGG. The system shall allow the User to select which Hotlists should be active at any given time.

HHH. The system shall be able to run in a 64-bit architecture and be able to support larger Hotlist files when in this mode.

III.   The system shall allow the Font size to be adjusted in the application for better visibility on different resolutions.

JJJ.   The system shall support the Windows 10 Operating system. (As well as support for Windows 8.1 and Windows 7).

KKK.   The system shall include and support the use of Microsoft SQL 2014 Express.

1.5   SYSTEM PERMIT VERIFICATION SOFTWARE

A.   The in-vehicle application shall be configurable to support Permit Enforcement

B.   The in-vehicle application shall have a GPS assisted lot selection to facilitate the selection of an enforcement zone.

C.   The application shall be capable of supporting a minimum of 1,000,000 permit entries.

D.   The application must be responsive in comparing a captured license plate against multiple and voluminous databases with less than a 2 second response to a query of a database containing 1,000,000 entries.

E.   When permit enforcement is enabled, if a user manually captures a license plate, this license plate shall automatically be matched against the permit database.

F.   Upon receiving a permit hit, the in-vehicle application will display the following information: Image cut out of the license plate, Color context image of the vehicle, License plate interpretation, Camera identification, Date and timestamp, GPS coordinates or, as an option, street address and map view of the location of the hit.

G.   Any hits which have not been acknowledged by the user shall be displayed as unresolved hits in the interface until they are acknowledged or resolved. The system must continue to process license plate data in the background and all captured data must be stored.

H.   Upon a hit, if the permit hit license plate does not correspond to the actual license plate cut out image, the user may select to edit the license plate interpretation. The original hit is automatically rejected and the edited license plate is automatically matched against the permit database.

I.   If permit enforcement is activated, hotlist matching will continue to be supported. to alert the user of any hit.

J.   When permit enforcement is enabled, the in-vehicle application shall be able to display statistics on the stored number of hits for the selected zone.

K.   The in-vehicle application shall be configurable to support or to not support Overtime Enforcement

L.   The application must be capable of being configured to do time-limit enforcement. Time Limit Enforcement involves reading all the license plates in a zone at time 1. All the license plates in the same zone are then read again at time 2. In cases where the elapsed time between time 1 and time 2 exceeds the allowed time limit for the zone, License plates read at both time 1 and time 2 are notified as hits.

M.   When time-limit enforcement is enabled, if a user manually captures a license plate, this license plate shall automatically be marked for time-limit enforcement.

N.   The in-vehicle time-limit enforcement must support the following parking types of violation: Same position: if a vehicle has been parked in the same position over the time limit allowed; Block Face: if a vehicle has been parked anywhere on both sides of the same block over the time limit allowed; District: if a vehicle has been parked anywhere in a district, for example a predetermine area of a city, over the time limit allowed

O.   Upon receiving a time-limit hit, the in-vehicle application will display complete original read information, the complete second read information that induced the infraction, as well as the elapsed time the vehicle has been parked, the type of zone and the total number of violations the vehicle has incurred.

P.   Any hits which have not been acknowledged by the user shall be displayed as unresolved hits in the interface until they are acknowledged or resolved. The system must continue to process license plate data in the background and all captured data must be stored.

Q.   Upon a hit, if the time-limit hit license plate does not correspond to the actual license plate cut out image, the user may select to edit the license plate interpretation. The original hit is automatically rejected and the edited license plate is automatically matched against matched against the saved time-limit enforceable reads.

R.   If time-limit enforcement is activated, the system will continue to support hotlist enforcement to alert the user of any hit.

S.   When time-limit enforcement is enabled, the in-vehicle application must be able to display statistics on the stored number of hits for the selected zone.

T.   The system must support the concept of shared permits where more than one vehicle from a given household can park in an authorized permit zone, but not at the same time. The system shall detect if more than one vehicle sharing a permit are parked in a zone at the same time and advise the operator of this violation.

U.   The System shall allow the sharing of previously read license plates for a selected zone between different enforcement vehicles via a secure Cloud Environment.

V.   The System shall allow for Hits to be generated based on previously read License Plates that have been shared from another Enforcement Vehicle

W.   The System shall allow for both Overtime and Shared Permit Violations based on License Plate Reads shared from another Enforcement Vehicle

X.   The System shall allow for the transfer of images associated to read data for the purpose of enforcement between Enforcement Vehicles (including License Plate Image, Color Overview Image and associated Tire or Wheel images depicting the position of the Valve Stem)

Y.   The System shall allow the user to verify the Status of the Uploading of previously read License Plate Data to the secure Cloud environment

Z.   The System shall allow the user to verify the Status of the Downloading of previously read License Plate Data from the secure Cloud environment

AA.   The System shall allow the user to verify in Real Time the number of License Plate Reads that have been Sent or Received between the Enforcement Vehicle and the secure Cloud Environment

BB.   The System shall allow the user to verify in Real Time the number of License Plate Reads that are Pending transfer to the secure Cloud Environment

CC.   The System shall be capable of a secure connection between the Vehicle Application and the secure Cloud Environment via Certificate

1.6   WARRANTY AND SOFTWARE/FIRMWARE UPDATES

A.   The complete LPR system and all related devices shall be covered under a 5-year warranty with all costs inclusive to vehicle procurement costs.

B.   For the duration of the 5-year warranty period the contractor shall be responsible for all software and firmware updates of all devises installed on the vehicles as required. These updates shall have no cost to the Authority and will be done at the Contractor's expense.

C.   Updates will be bench tested for a minimum of 30 days by the Contractor and bench testing shall include all features and functionality as it exists in the enterprise systems.

D.   All planned updates will be coordinated with the MBTA project management team and coordinated with MBTA Vehicle Engineering to minimize the impact to revenue service.